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LANDSAT 4 BAND 6 DATA EVALUATION

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Fourth Quarterly Report

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Objectives:

The objectives of this investigation are to evaluate and monitor the radiometric integrity of the Landsat-D Thematic Mapper (TM) thermal infrared channel (band 6) data to develop improved radiometric preprocessing calibration techniques for removal of atmospheric effects.

Problems:

Continued lack of simultaneous TM and underflight data is delaying much of the major thrust of the effort. At present we are anticipating that time extensions will be required to complete the program. Until scheduled TM data collection resumes, it is difficult to estimate completion schedules or any costs that might be associated with a time extension.

Accomplishments:

Efforts during this reporting period were directed at improvements to the atmospheric propagation model. In particular these efforts were designed to improve the correlation of modeled data with experimental data. To this end, multiple altitude thermal infrared images were analyzed and the observed radiance (L) values computed using the procedure illustrated in Figure 1. These data represent an experimental relation between perceived radiance and altitude. Ideally this relationship could be predicted by atmospheric models such as LOWTRAN 5A. On this effort we are experimenting with an improved version of the LOWTRAN approach which incorporates a modification to the path radiance model. This modification assumes that the scattering out of the optical path is equal to the scattering into the path in magnitude and direction. Alternately phrased it assumes that the atmospheric constituents are black bodies. One example of the results of this assumption is shown in Figure 2. Here we see that the LOWTRAN code monotonically reduces path radiance even above the atmosphere. The modified code more satisfactorily indicates that path radiance reaches a maximum at the limits of the atmosphere and remains constant. The radiance observed at altitude by the aircraft sensor was used as input to the code. Expected radiance as a function of altitude was then computed down to the ground. These results are plotted in Figure 3. These results were not very satisfactory from two perspectives; first because of somewhat large errors in temperature, and secondly because of the difference in the shape of the modeled and experimental curves (i.e., apparent temperature increasing with altitude in one and decreasing in the other). A closer look at the data used to construct the modeled atmosphere showed that the available radiosonde data showed a strong radiational inversion (cf. Figure 4). The radiosonde data were obtained at 7:00 A.M. and the flight data were collected 3-4 hours later. By this time the thermal inversion had burnt off. By adjusting the radiosonde data to compensate for this a much better fit between the experimental and modeled data was obtained (cf. Figure 5). The modifications to the radiosonde data were only made to atmospheric temperatures and were only applied to path radiance calculations. Future efforts will attempt to identify a more

systematic and thorough correction method. These data were somewhat limited by experimental error. The aircraft data used were not collected specifically for this purpose and hence had somewhat more errors than desirable. Future efforts should have less experimental error.

In light of these results we are currently planning to collect atmospheric temperature, pressure and relative humidity data from the aircraft as a function of altitude on future satellite underflights. These data should help to improve the atmospheric propagation models potential for absolute radiometric calibration of the spacecraft sensing system.

Significant Results:

None this reporting period.

Publications:

None this reporting period.

Recommendations:

None this reporting period.

Funds Expended:

Data Utility:

N/A

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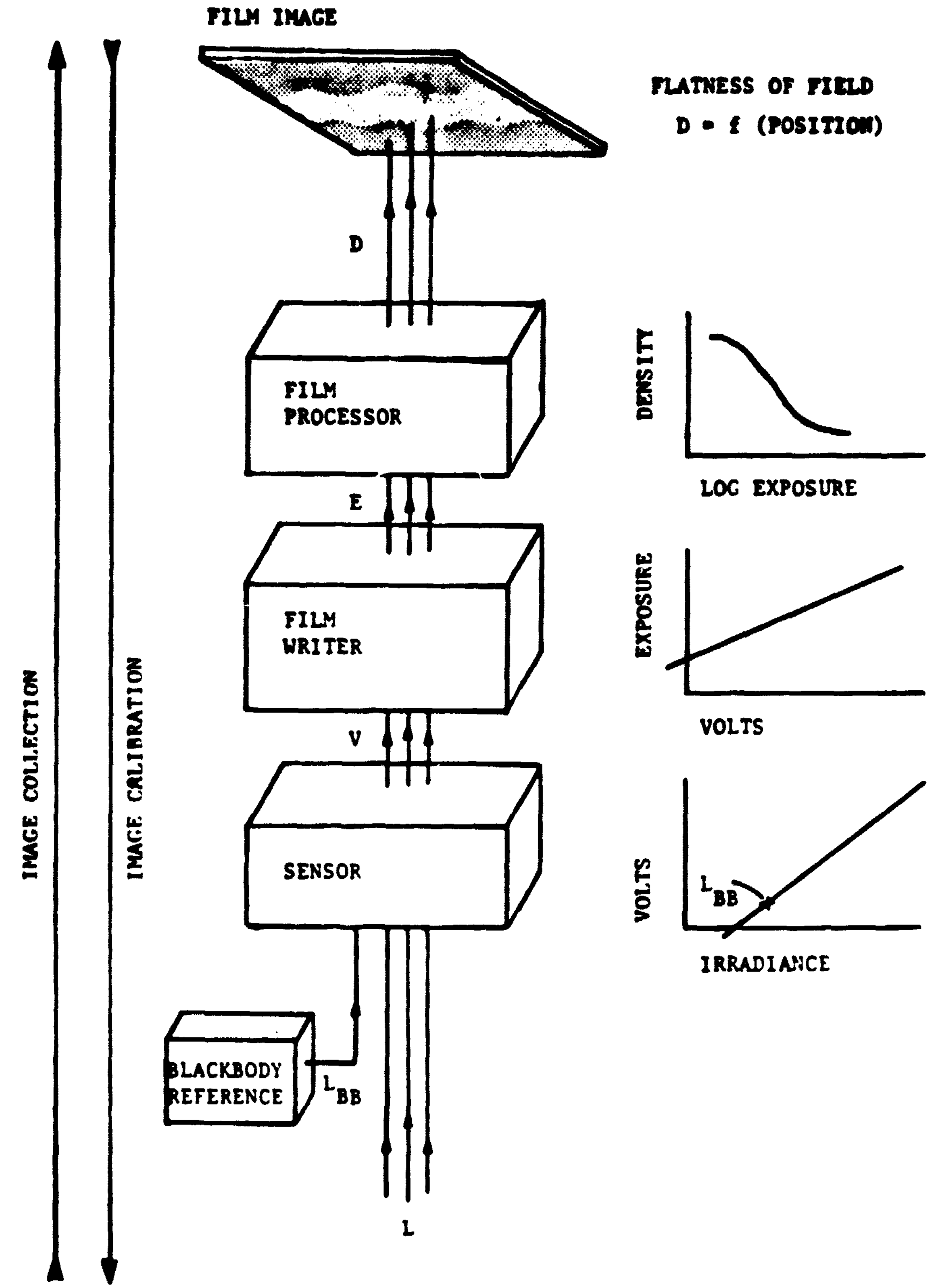

FIGURE 1. CALIBRATION OF IMAGERY FOR QUANTITATIVE DATA EXTRACTION

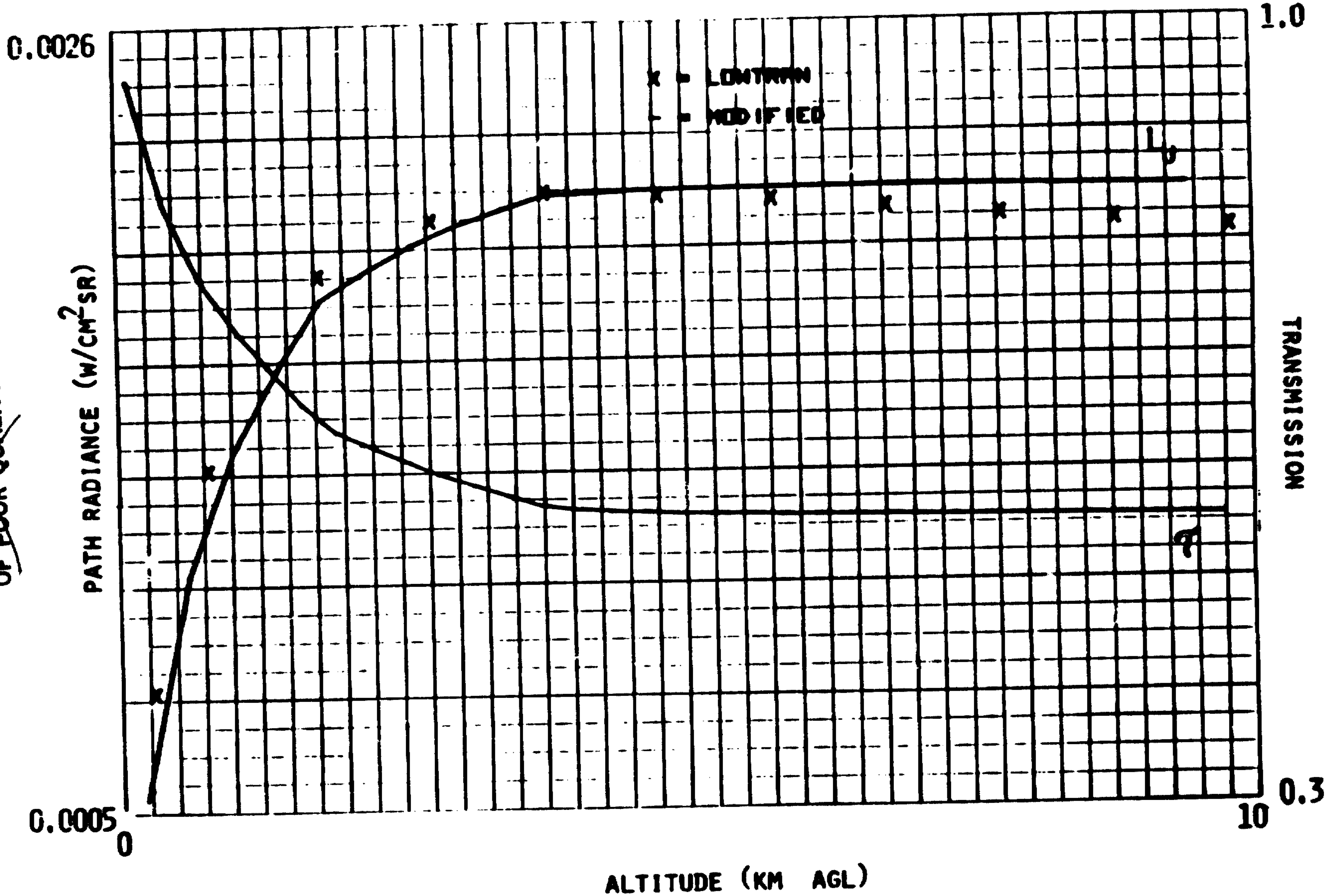

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FIGURE 2. PATH RADIANCE AND TRANSMISSION AS A FUNCTION OF ALTITUDE

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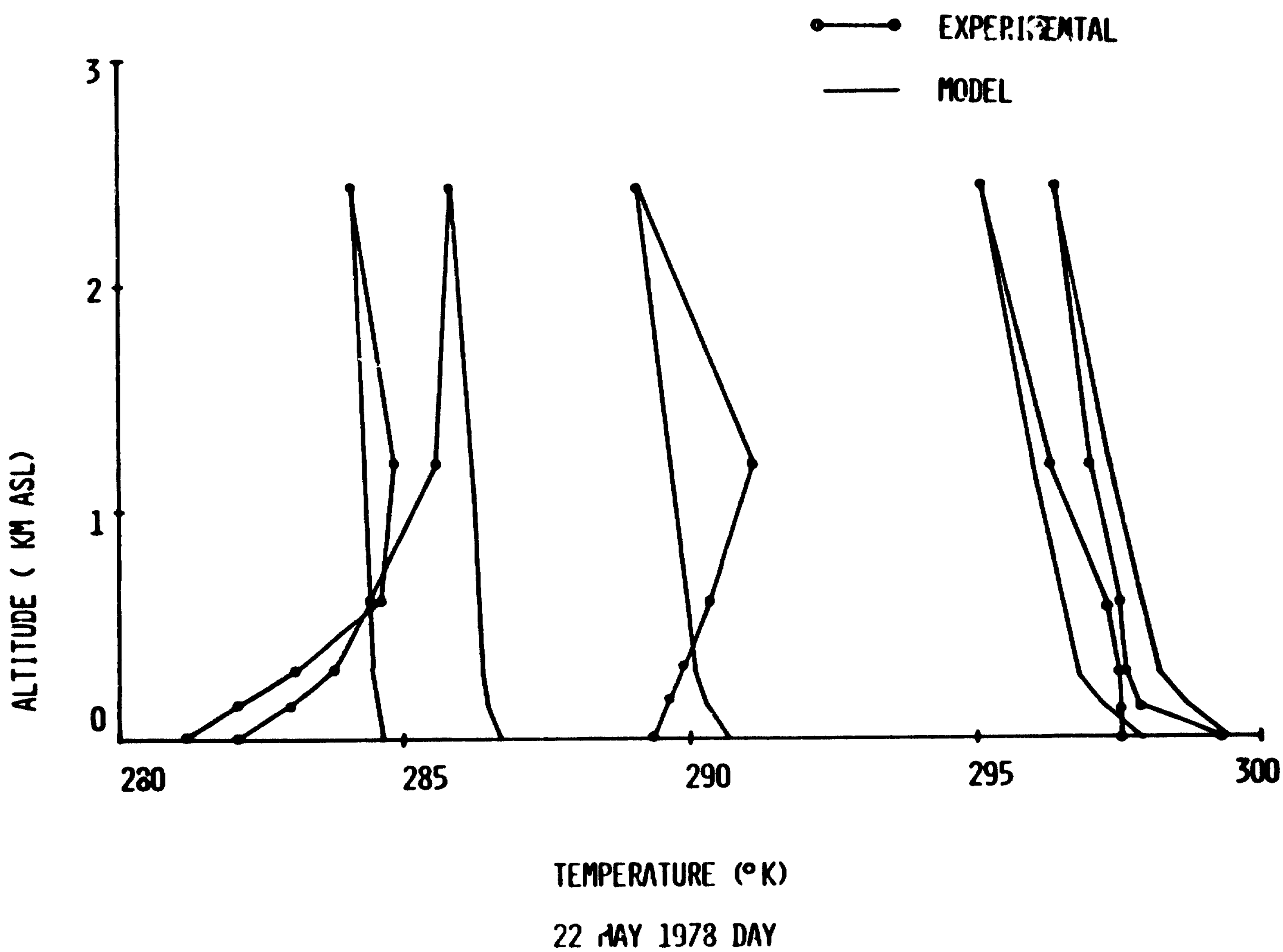

FIGURE 3. COMPARISON OF EXPERIMENTAL AND MODELLED TEMPERATURE DATA AT VARIOUS ALTITUDES

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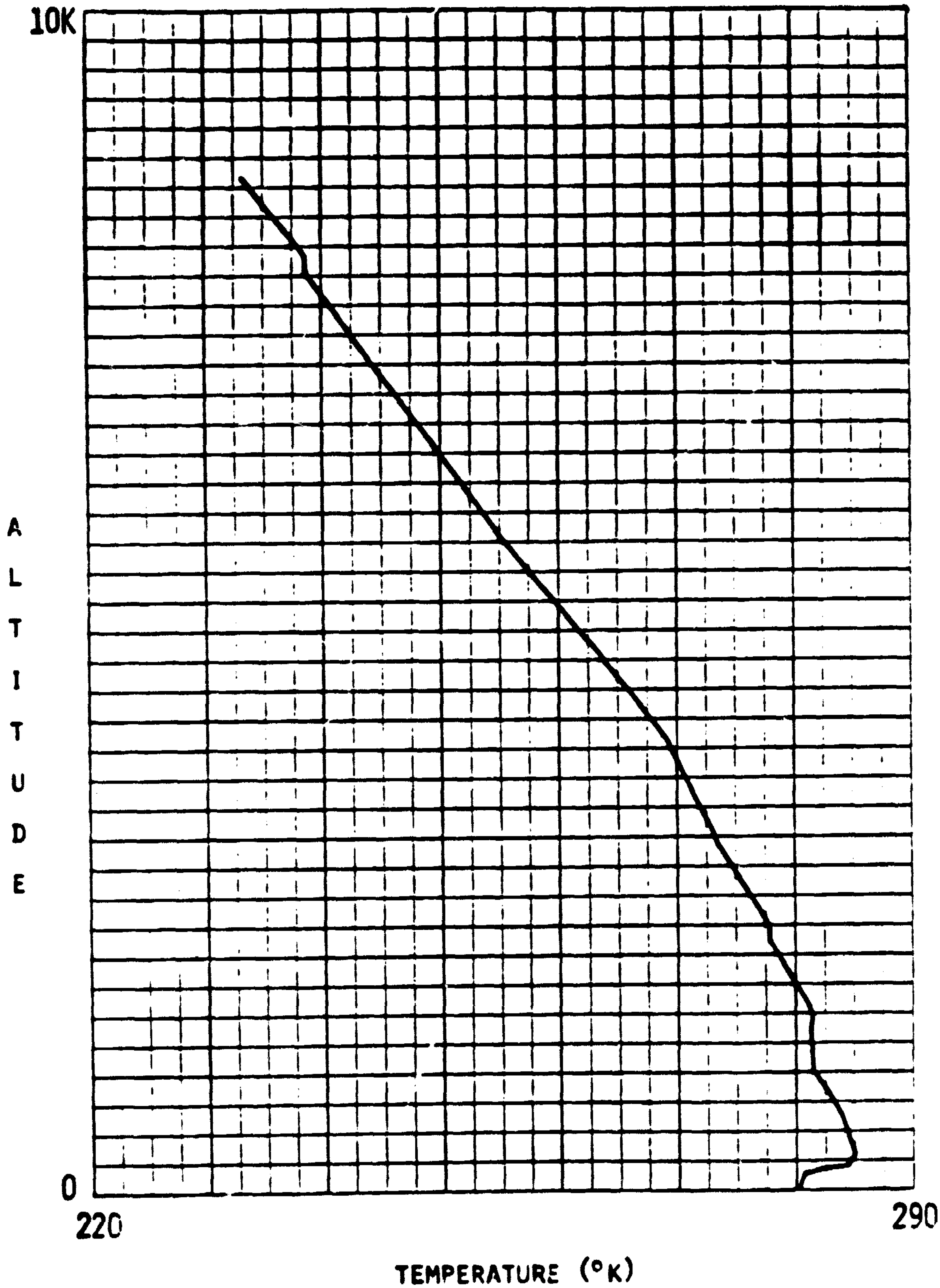

FIGURE 4. RADIOSONDE DATA -- 22 MAY 1978

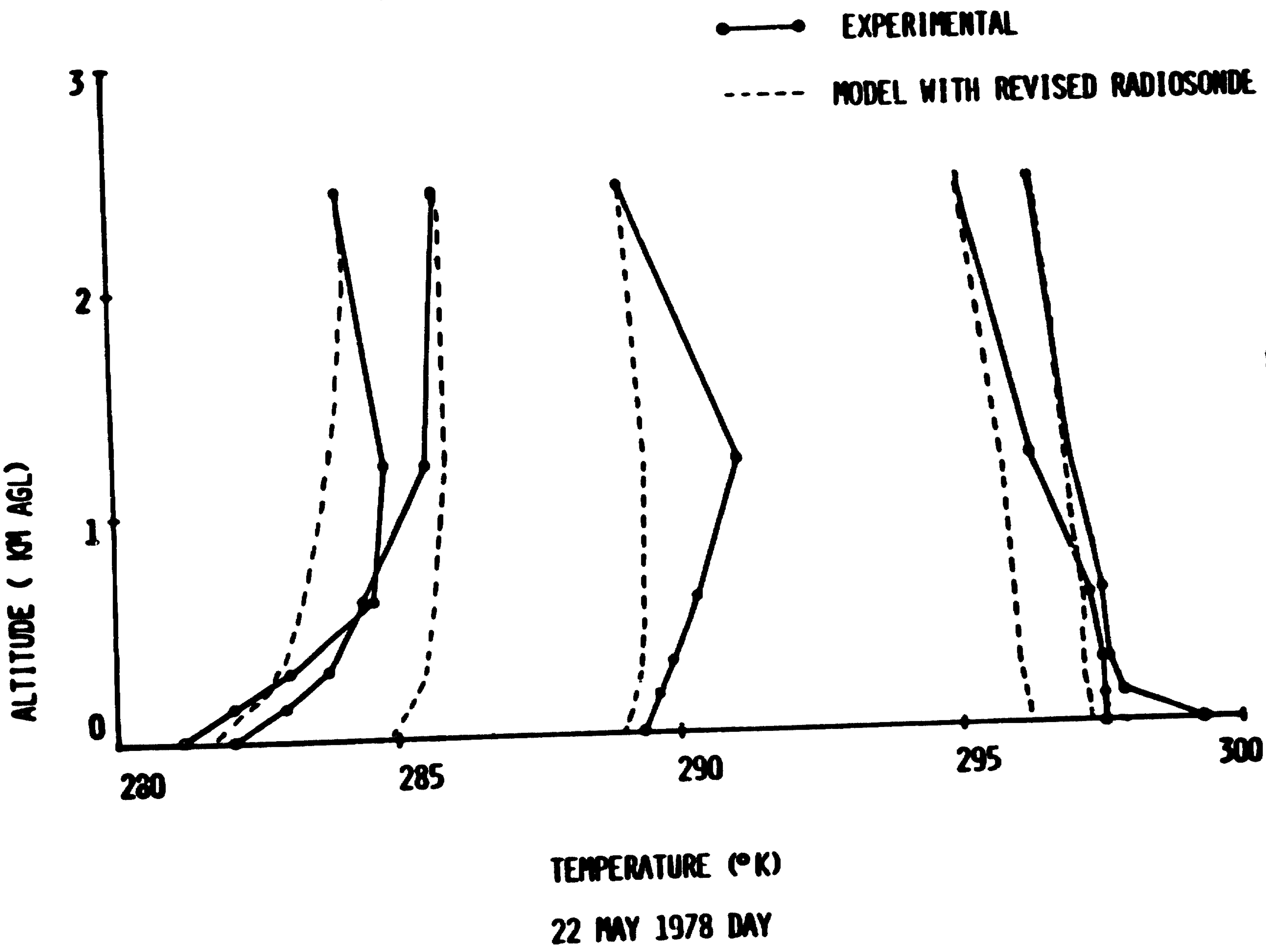

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FIGURE 5. COMPARISON OF EXPERIMENTAL AND MODELLED TEMPERATURE DATA AT VARIOUS ALTITUDES